GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)/ MECHANICAL (MACHINE DESIGN) (09)
QUALITY CONTROL AND RELIABILITY
SUBJECT CODE: 2740804
SEMESTER: IV

Type of course: Post Graduate

Prerequisite: Zeal to learn the subject

Rationale:
The aim of this course is to make students understand and appreciate the importance of quality control and reliability analysis in industrial system. Students can get acquainted with different reliability calculation models. The course is also aimed at making students aware of latest quality improvement methodology like Six Sigma.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No	Topic	Lectures	Weightage
1	**Introduction:** Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost.	**2**	**5%**
2	**Process Control for Variables and Attributes:** Causes of Variation, Control Charts for Variables (Mean and Range, Mean and Standard Deviation, Cumulative Sum Control Chart), Control Chart Patterns and Corrective Actions, Control Charts for Attributes (p-chart, np-chart, c-chart, u-chart), Acceptance Sampling Plans (Concepts of Producer's and Consumer's Risks, Types of Sampling Plans and their merits and demerits, Operating Characteristic Curve, Average Outgoing Quality Curve), Errors in Making Inferences from Control Charts (Type I and II errors)	**8**	**20%**
3	**Designing for Quality:** Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application	**5**	**10%**
4	**Six Sigma Fundamentals:** Basic Concept, Methodology, Process Improvement Model (DMAIC) Steps (Objectives, Tools and Techniques Used), Six Sigma Organization, Six Sigma Implementation Requirements, Introduction to Lean Manufacturing.	**6**	**10%**
5	**Reliability Engineering:**	**10**	**20%**

	Reliability function, failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions. Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.		
6	**Reliability Determination and Prediction:** Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method. Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis. Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.	**10**	**15%**
7	**Reliability Management:** Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.	**8**	**15%**
8	**Risk Assessment:** Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.	**3**	**5%**

References Books:

1. Grant E L, Statistical Quality Control", McGraw-Hill.
2. Shrinath L S, Reliability Engineering" Affiliated East west press.
3. Besterfield D H, Quality Control, Prentice Hall.
4. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
5. Connor P.D.T.O. Practical Reliability Engineering", John Wiley.
6. Naikan V N A Reliability Engineering and Life Testing", PHI Learning Private Limited.
7. Prabhakar Murthy D N and Marvin R, "Product Reliability", Springer-Verlag.
8. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.
9. John W Priest and Jose M Sanchez, "Product Development and Design for Manufacturing – A Collaborative Approach to Producibility and Reliability", Second Edition, Marcel Dekker.

Course Outcome:

On completion of this course students will be able to:

1. Understand the concepts of quality control, improvement and management.
2. Understand the concept of design for quality.
3. Understand the concepts of reliability.
4. Understand and carry out reliability data analysis.
5. Get acquainted with various reliability prediction and evolution methods.
6. Learn fundamentals of reliability management and risk assessment.

List of Experiments:

1. Exercise on Control Charts for Variables and Attributes
2. Case Study on FMEA
3. Case study on implementation of Six Sigma
4. Exercise on reliability concepts and calculations of MTBF and MTTF
5. Exercise on reliability data analysis.
6. Exercise on reliability mathematics, bath-tub curve.
7. Exercise on reliability prediction model.
8. Exercise on risk assessment.
9. Estimating reliability of a mechanical component and validating from the published / available / experimental data and suggest design modifications if required.

Major Equipment:

1. Software for statistical analysis (like SPSS or MiniTab)

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.